

Smithsonian Astrophysical Observatory

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Type I Progress Report March 1 - April 30, 1973

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Discipline and Sub-Discipline 3. Mineral Resources, Geological
Structure and Landform Surveys
J. Lithological Surveys
K. Structural Surveys

- a) TITLE: Mapping of the Major Structures of the African Rift System, Proposal Number 320
- b) PRINCIPAL INVESTIGATOR: Dr. Paul Mohr OT-306

- c) A STATEMENT AND EXPLANATION OF ANY PROBLEMS:
Dr. Mohr has made a couple of attempts to change his data order using the required forms. However, the latest Standing Order Summary of April 6 shows the changes have not been incorporated. He has therefore enclosed the summary showing the desired changes a deletion of areas 1 and 2.

DISCUSSION OF ACCOMPLISHMENTS DURING PERIOD:
Beginning in mid March, Dr. Mohr accompanied by Eric Potter (a graduate student) made a two month mapping safari to Ethiopia. Their work centered on the Arussi Mountains and provided ground-truth correlation with the ERTS imagery under analysis by Dr. Mohr.

SEPARATE DISCUSSION OF SIGNIFICANT RESULTS:
ERTS-1 ground-truth investigation of a margin sector of the Ethiopian rift valley.
ERTS-1 imagery of the African rift system has already proved of great value in structural geological studies. One of the interesting megastructures expressed on the imagery (notably, image E-1191-07095-5 of 30 January 1973) occurs some 40km east of the eastern margin of the main Ethiopian rift, in Arussi province, and extending between latitudes $7\frac{1}{2}$ and $8\frac{1}{4}$ °N. This is the meridionally trending Sagatú (or Badda-Encuolo) ridge, and attendant major volcanic centres to the west of the ridge terminations. This region was chosen for selected detailed field and subsequent laboratory studies, the former in cooperation with Haile Selassie I University Geophysical Observatory.

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(E73-10622) MAPPING OF THE MAJOR
STRUCTURES OF THE AFRICAN RIFT SYSTEM
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5 p HC \$3.00

The Badda-Encuolo ridge proves to have been a line of major Tertiary volcanism, controlled by extensional tectonism, and probably supplied the thick Trap Series flood basalt sequence exposed farther east in the canyons of the Webi Shebeli drainage system. These basalts are not exposed by the rift escarpment, west of the ridge, where they are apparently downwarped beneath a thick cover of more-silicic volcanics, derived from later volcanic episodes of the Sagatú lineament and its attendant centres.

The ridge itself was built up by the waning activity of the Sagatú line of volcanism. This activity was dominantly expressed as trachytic lavas, pierced by trachytic and basaltic (and some hybrid) plugs and dykes. Some of the larger minor intrusions can be recognised on the ERTS-1 imagery. A particularly concentrated zone of dyke-injection was discovered and examined on the southwestern flanks of Mt. Badda. There, a 1250m-wide zone contains more than forty NNE-trending dykes which comprise 20 percent of the total width, indicating an early phase of rift extension outside the present rift valley graben, and slightly oblique to the trend of the ridge. Sixty percent of the dykes in this swarm are trachytic, the rest more mafic or hybrid. There is evidence that early, exposed dykes were associated with monoclinical warping of the fed lavas, west down into the proto-rift trough.

Serendipitous has been the discovery on Mt. Badda of several deeply glaciated valleys, many of which show clearly on the ERTS-1 imagery. Cirques, hanging walls, lintels, lateral and terminal moraines, polished and beautifully striated rocks, were mapped. It seems that Mt. Badda was one of the most important glacial centres in eastern Africa during the Pleistocene.

Three major late-Tertiary trachytic centres lie between the Badda-Encuolo ridge and the rift valley: Chilalo, immediately west of Badda, and Kakka and Baltata west of Encuolo. The relationships of these three volcanoes to each other and to the rift faulting is revealed for the first time by the ERTS-1 imagery, as is the form of the caldera of Baltata and the crater of Chilalo.

Mt. Kakka was chosen for a detailed field investigation. It proves to be a rather low-angled shield in which trachytic lavas greatly predominate, but with occasional tuffs and also basaltic units. A basalt plug occurs within the summit pseudo-crater (note: on the highest, southern part of the 'crater' rim, the lavas are observed to be draped over the rim - the 'crater' has been partly excavated by localised glaciation). Mt. Kakka volcano is unlikely to have been a source for the thick series of draped ash-flow tuffs in the Katar basin, to the north, and Chilalo or possibly Baltata seems the responsible agent. These ash-flow tuffs lie upon the ridge volcanics.

Detailed stratigraphic, petrological and petrochemical investigations of the Badda and Kakka regions are the subject of a graduate thesis by Potter (Oregon State University). These investigations should throw important light on the early volcanic and tectonic evolution of the main Ethiopian rift. The Pleistocene glaciation of the region is the subject of a paper now in preparation.

- f) PUBLICATIONS: None during the period.
- g) RECOMMENDATIONS: None
- h) (see c above)
- i) ERTS IMAGE DESCRIPTOR FORMS, FOR RETROSPECTIVE DATA: None.
- j) LISTING BY DATE OF DATA REQUEST FORMS, FOR RETROSPECTIVE DATA: None.
- k) The funds remaining are adequate for the period of the contract.